IV. *On the north polar distances of the principal fixed stars.* *By* John Brinkley, *D. D. F. R. S. &c. Andrew's Professor of Astronomy in the University of Dublin.*

Read December 18, 1823.

The apparent disagreement of the Catalogues of North Polar distances of the fixed stars, as given by different astronomers, has lately excited considerable attention. Many persons may be induced to imagine, that the means of making observations are not in so perfect a state as has been supposed.

The following examination of some important points relative to this subject, will, I hope, be deemed not unworthy of the notice of the Royal Society.

A comparison of the North Polar distances of Mr. Pond and Mr. Bessel, with my own, may give occasion to some useful enquiries. It will give me an opportunity of stating the results of my researches relative to southern motion, to which my catalogues of 1813 and 1823 are, as is known, quite opposed.

In discussing these subjects, I hope I shall be considered as searching after truth, not as handling a useless controversy, than which nothing can be more injurious to science. It will be necessary for me to enter into a considerable detail, I shall therefore briefly state the objects of the following enquiries.

Of the recent Catalogues that have been formed of the principal fixed stars, two, those of Dublin and Greenwich, agree very exactly. That of Mr. BESSEL differs considerably; but the differences are such that they would agree by a modification of the constants of refraction used. This leads me to some considerations respecting the different modes in which my Tables of Refraction, and those of Mr. BESSEL, have been constructed. I do not venture to decide which Catalogue will ultimately be found more correct, that of Dublin, and consequently that of Greenwich, or that of Konigsberg.

Mr. POND, however, does not admit the agreement of the Dublin and Greenwich Catalogues, because we use different refractions, and for comparison, takes my column of North Polar distances, computed by BRADLEY's refractions.* From the differences then resulting, he infers a flexure of my instrument. But that such reasoning is inconclusive, will, I think, appear from what I shall afterwards state.

In asserting the general agreement of the Catalogues of Dublin and Greenwich, both for 1813 and 1823, I mean, they agree within certain narrow limits. The mean of the differences of the Catalogues of 1813 is only a few tenths of a second. The mean of the differences of the Catalogues of 1823 is still less. It must therefore at first view appear extraordinary, that from the comparison of the two Catalogues

* It ought to be noticed that Mr. POND, in his paper in the First Part of the Philosophical Transactions for 1823, has omitted to state distinctly, that the polar distances he reasons on respecting the flexure of the instrument, &c. are not what I consider as my polar distances. In one Table, indeed, he puts "by BRADLEY's refractions" at the head. But even here a reader might suppose that they were the North Polar distances as given by me. In the same Table he places BESSEL's unchanged, by the side of mine changed, and compares them together.

of Greenwich a southern motion is deduced, whereas none appears from a comparison of the two Dublin Catalogues; but this is easily explained by an examination of the Catalogues.

From the weight of external testimony that I shall adduce, I think it will readily be conceded to me, that the southern motion does not exist. It will follow, therefore, that the mean Southern motion must be regarded as an error belonging to one or both of the Greenwich Catalogues of 1813 and 1823. It may be inferred, that the mean error principally belongs to the Catalogue of 1813, as the mean exactness of the Greenwich Catalogue of 1823 may be inferred from its agreement with the Dublin Catalogue of 1823. This is the only way it can be inferred. The observations by reflection only go to prove a relative exactness; for, in consequence of the Pole Star not having been observed at Greenwich by reflection, it was necessary for Mr. POND to assume the latitude of Greenwich, more or less, to accommodate it to the mean error of the Catalogue.

In my researches relative to the Southern motion, I have been able to avail myself of the result of important observations by Dr. BRADLEY, made at Wanstead, in 1728; of zenith observations made in France, in 1740; of Dr. MASKELYNE'S observations at Schehallien, in 1774; of General MUDGE'S observations with the zenith sector, in 1802; and of General LAMBTON'S zenith distances observed in the Mysore, in 1805.

All these observations were made with instruments not inferior to the zenith sector with which BRADLEY so exactly ascertained the quantity of the aberration of light, and it is not necessary for my purpose to suppose them superior.

It has been said, that the Westbury observations of Mr. Pond confirm the Southern motion, as also a few stars observed by Mechain, in the late French measurement. But the irregularities to be found in comparing the Westbury Catalogue with the two Catalogues by the Greenwich mural circle, show that the former cannot be of any use in this enquiry. The few French results that appear to support the Southern motion, are opposed to other results by better instruments.

The Palermo Catalogue, published by M. Piazzi, as containing the correct result of all his observations, when compared with Bradley's Catalogue of 1755, and the two Dublin Catalogues afford a remarkable testimony in favour of the uniformity of the annual variation in declination of the principal stars.

This result of the question of the Southern motion, appears adverse to the opinion advanced by Mr. Pond, relative to the decided superiority of the Greenwich over the Dublin circle. If we are to judge of the instruments by the observations, I am probably right in the opinion I have long entertained, of the unfitness of the Greenwich circle for the accurate investigation of small motions. Whereas I have generally found my instrument consistent in that respect; unless it be said, it has deceived me in regard to the parallax of α Lyræ. This, resting on the authority of the Greenwich instrument, I am not at present disposed to admit. I had intended concluding with some notices respecting Mr. Pond's paper "on the Parallax of α Lyræ," read before the Royal Society on the same day as that relative to the Southern motion; but as that paper requires to be particularly remarked on, I

shall here confine myself to the consideration of the North Polar distances, and as connected therewith of the Southern motion.

On the Catalogues of North Polar Distances.

I have placed, in Table I., beside each other, the North Polar distances observed at Greenwich about 1813, and at Dublin about the same time, together with the differences. In like manner have been placed also the Greenwich and Dublin North Polar distances of 1823, together with the differences. An inspection of these will show, except in one or two instances, a very extraordinary agreement. Many of the Polar distances differ by less than 1″; and with the exception of Sirius, in the Catalogue of 1813, the differences are never greater than what might arise from accidental circumstances. The Greenwich Catalogue of 1813 is *less* in its mean quantity than that of Dublin by 0″,47, and the Greenwich Catalogue of 1823 is greater than that of Dublin in its mean quantity by 0″,10. But we are to consider that these Catalogues are computed by different tables of refraction. The constant of refraction $\left(\frac{m-1}{\text{Sin.}1''}\right)$ in BRADLEY's table (that used by Mr. POND) is 57″. In my Table it is 57″,72.

My constant has been determined by the circle and the meteorological instruments used here, and therefore must necessarily be adopted for my observations. When an astronomer has found the constant of refraction by his own instruments, his Catalogue of North Polar distances ought to be formed independently of any other instrument or table of refractions. No partial change can be admitted. Mr. POND,

however, as has been mentioned, has done otherwise, and applied BRADLEY'S refractions to my Catalogue.*

I particularly regret this circumstance, because it has occasioned my Catalogue to appear to differ more from that of Mr. BESSEL, than it really does. The differences that actually exist are sufficiently difficult to account for. Indeed had Mr. POND also reduced the Catalogue of Mr. BESSEL by the same refraction, the differences would have appeared much better. But this mode of proceeding would not have been less objectionable. From the differences between his own Catalogue and my Catalogue reduced, Mr. POND infers that my telescope is subject to flexure by the quantity of the difference at each zenith distance. Now it must appear a very extraordinary law, and not easily reconcilable to any mechanical principle, that the flexure should be nearly as the tangent of the zenith distance. This it must necessarily be according to his method of changing my North Polar distances.

It is evident, by comparing the two Catalogues, that there is no difference between them but what might arise from unavoidable errors. Had each star been exact to the tenth of a second, still Mr. POND'S reasoning would have led him to do the same. He would have reduced them by BRADLEY'S

* It may be said, that in a Paper in the Transactions of the Royal Irish Academy, about eight or nine years ago, I changed *my own* North Polar distances for the purpose of comparison. But the circumstances are entirely dissimilar. I have always referred to, and always used, the North Polar distances computed by my own refractions.

Mr. BESSEL, in his comparison of my polar distances with his own, does not change mine to adopt his own refractions. He knew I had determined my own with my own instruments.

refractions, and so made the Catalogues differ. He attributes the differences to flexure. Now he admits that the flexure would be the same at equal distances on each side of the zenith; but it does not appear to have occurred to him that my refractions were determined by observations of circumpolar stars to the north of the zenith by the same instrument, and that therefore they must be *exactly* in error by the quantity of flexure; and so when applied to stars south of the zenith, must *exactly* compensate for the effects of flexure.* Mr. POND did not perceive that what he took away with one hand, he ought to have restored with the other, and so left my Catalogues as he found them.

It is difficult to say how far the difference of our constants of refraction may be occasioned by a discordance in the meteorological instruments. This should be enquired into. It is still more difficult to imagine a difference in the mean refractions at the two places.

* The manner in which the telescope and circle are attached in the Dublin instrument, appears to preclude all probability of flexure in the telescope. Indeed it does not appear a matter of much difficulty where the telescope and circle are combined together, as in the Dublin and Greenwich instruments, to guard against a flexure in the telescope. If talents such as those of Mr. RAMSDEN and Mr. TROUGHTON have been unable to provide against the flexure of the telescope, it appears to me quite useless to expect exactness in the other parts of the instruments. Therefore, it might be considered as almost a waste of time to endeavour to overcome the difficulties I should have to encounter here by observing by reflection. The difficulties in general would be greater than at Greenwich; and, above all, among the few clear days that occur, very few could be found sufficiently calm to observe by reflection.

Mr. POND had a motive for pursuing this mode of observation which does not exist here; he had no other method of determining his zenith point. I do not consider the observations by reflection necessary for my own satisfaction, but if they be for that of others, I should not object to undertake them.

In whatever way the subject is considered, the coincidence of the Greenwich and Dublin Catalogues speaks in the strongest manner for the excellence of the divisions of both instruments.

This coincidence will, if I mistake not, appear in a stronger point of view, by deducing the co-latitude of Greenwich from applying the zenith distance of each star, as observed by reflection at Greenwich, to the Polar distance of the same star as given in the Dublin Catalogue for 1823. The results are given in Table 2. The mean of the 30 stars is 38° 31′ 20″,8, or two tenths of a second less than that assumed by Mr. POND, and four tenths greater than that found by Mr. BESSEL, *from Dr.* BRADLEY'S *observations.*

The difficulty that has arisen from the comparison of the Greenwich and Dublin Catalogues with that of Mr. BESSEL, is now to be considered. In this also, there will, I think, be nothing found adverse to that degree of accuracy, which is supposed to belong to modern instruments and modern observations.

It will readily appear, that the differences between the Dublin Catalogue and that of Mr. BESSEL, are equivalent to a change in the constant of refraction of about one second. If, in computing the Dublin observations, we increase my constant of refraction by half a second, and in computing the Konigsberg observations, we decrease Mr. BESSEL'S constant of refraction by half a second, the Catalogues will be found to agree sufficiently.

It is not necessary to search for other causes till we are assured this is not the true one. The investigation of the

exact constant of refraction will be found one of great difficulty, if we consider the nature of it. Mr. BESSEL and I have proceeded by different methods, and, in some respects, my method appears more likely to lead to an accurate result.

Mr. BESSEL's object is to obtain a formula that shall embrace all elevations from the zenith to the horizon, and, therefore, he necessarily assumes a law of variation of density in the atmosphere.

In my investigation, I only consider zenith distances not greater than about 75° or 76°, where no sensible effect is produced from our ignorance of the law of variation of density. Let us consider the advantages and disadvantages of each method.

Mr. BESSEL* supposes the equation of density to be

$$\rho = (\rho)\, e^{-\frac{g-l}{g-l}\, a s}$$

ρ being the density at the height, *as* & (ρ) that at the surface, a being the radius of the earth, and l the height of an uniform atmosphere. He proposes to find g, so that the formula of refraction deduced may satisfy the observations. He has therefore two unknown quantities, g, and the constant of refraction, k.

When we consider the irregularities of refraction at low altitudes, and the number of observations required to make those irregularities disappear, it may be thought that the problem is unnecessarily involved by requiring the investigation of two unknown quantities, and, under the circumstances of the case, there is reason to suppose that the observations may be satisfied within certain small limits, by assigning values

* Astronom. Fundament. p. 28.

to k, even differing $1''$, by making corresponding changes in g, so that the problem partakes too much of the nature of an indeterminate one. Thus the advantage apparently gained by large refractions, is lost by attendant inconveniencies.

In my investigation, there is only one unknown quantity, but then I have much smaller quantities to work with.

Theory gives as far as about 76°, whatever be the law of variation of density in the atmosphere.

* The mean refraction $(r) = k \tan. z - \frac{k l \tan. z}{a \cos.^2 z}$ &c. (1), z being the zenith distance.

By a table of refractions, or by the pole star, and a star or stars more remote, k is easily obtained nearly. Then if the true value be $k + dk$

$$dr = dk \tan. z \ (2) \text{ sufficiently exact.}$$

Let A and B be the observed zenith distances of a circumpolar star, (considering B negative when south of the zenith) above and below the pole, R & R′ the refractions *exactly* computed by the formula (1), k being the approximate constant of refraction.

Then by (2)

$$\text{Co-lat.} = \frac{A + B + R + R' + dk \tan. A + dk \tan. B}{2}$$

Hence, if C represent the mean co-latitude thus determined by circumpolar stars remote from the pole, and N that by stars near the pole, we obtain an equation of the form

$$C + m\,dk = N + n\,dk$$

$$\text{and } dk = \frac{N - C}{m - n}$$

In this investigation the Z. D. of the stars remote from the Pole, should not be greater, when below the Pole, than about

* Transactions of the Royal Irish Academy, Vol. 12.

76° or 77°, and not less than about 69° or 70°. Let us suppose it in its mean quantity at about 73°, and then the value of m will be about $\frac{\tan. 73°}{2} = 1,6$, and for the stars near the Pole, the mean value of n about 0,7. Hence $m - n$ is less than unity, and, consequently, the error of the constant of refraction is greater than the error of N — C. Now I think it will be conceded to me, that it requires the exactest instruments and exactest observations to determine the quantity N — C certain to half a second. A greater number of stars can be used for determining C than for N, but then the greater zenith distances will probably occasion C to be more inexact than N. In C, the irregularities of refraction, and in N, the errors of division, have most influence.

In a series of observations in which I am at present engaged, for determining anew the constant of refraction, I use for N the Pole star only, and I lessen the effect of the errors of division, that may be apprehended, by being enabled to observe the Pole star in all parts of its daily course.

I shall not anticipate here the probable result of these observations.

The object of the above, is not to examine whether the constant of refraction has been determined with greater exactness at Dublin or at Konigsberg, but only to endeavour to show that the uncertainty, which exists, cannot be considered in any manner adverse to the received opinion respecting the exactness of modern observations and modern instruments.*

Before leaving this subject, I may be permitted to make a

* A catalogue of Polar distances necessarily exhibits, for low stars, the error of the constant of refraction as it were considerably magnified.

few remarks relative to one circumstance, that Mr. BESSEL relies on a good deal, as proving the exactness of his refractions, viz. that they give the obliquity of the ecliptic at the Winter and Summer solstices the same. Whereas other Tables of refraction give the obliquity in Winter less than in Summer.

We have lately commenced here to observe the zenith distance of the sun every day at noon, on which it can be seen.

I had formerly been unwilling to observe the sun with the circle, except at the solstices, as I considered the heat likely to derange the instrument for my observations relative to parallax.

The Dublin circle, in one respect, is well adapted for observing the sun. By observing a few minutes before and after noon, four observations give me the zenith distance of the centre, independently of the semi-diameter, or correction for collimation.

Observations on eighty-seven days have been obtained during the last year. The manner in which I have used them, is, I believe, somewhat new. With the declination in the Nautical Almanac, and the meridional zenith distance deduced from the observation, I obtain the latitude of the Observatory. I assume, that the declination in the Nautical Almanac is only erroneous by an error in the longitude (L) of the sun, and obliquity of the ecliptic (O). Then, for each day, I have the lat. $=$ Z. D. observed $\pm$ decli. $+ m\, d\, \mathrm{L} + n\, d\, \mathrm{O} + p\, d\, k$. From the nature of the Solar Tables it may be assumed, and the assumption is exact enough for my en-

quiry, that $d\mathrm{L}$ only arises from an error in the place of the equinox.

The mean of the latitudes thus found during the year, will be affected by an error $s\,d\mathrm{L} + t\,d\mathrm{O} + v\,d\,k$, in which the coefficients s and t are so small, that the effects of $d\mathrm{L}$ and $d\mathrm{O}$ will be insensible. Thus the eighty-seven observations give my latitude $= 53^\circ\ 23'\ 12'',39 + 0,04\,d\mathrm{L} + 0,21\,d\mathrm{O} + 1,42\ d\,k$.

By circumpolar stars remote from the Pole

Co-lat. $= 36^\circ\ 36'\ 47'',15 + 1,62\ d\,k$,

making the sum $= 90^\circ$,

we deduce $d\,k = 0'',15 - 0,01\ d\mathrm{L} - 0,07\ d\,\mathrm{O}$.

This small value of $d\,k$ appears to confirm the accuracy of the constant k that I had used. But if I relied on this I should deceive myself; for on examining the series of latitudes deduced, it is evident that this coincidence arises from the circumstance of more observations having been made while the sun was on the north side of the equator, than while on the south. The latitudes deduced show clearly, that had more observations been made nearer the winter solstice than the summer, the value of $d\,k$ would have been much more considerable.

This contradictory result, and some other circumstances that appear on an examination of the latitudes deduced, seem to point out that some new equation is required to be applied for the solar refraction. At least, that no conclusion can be drawn as to the exactness of a table of refractions, from its giving the obliquity of the ecliptic the same at the two solstices.

On the Southern Motion.

In Table III. are given the North Polar distances of forty-six principal stars, from recent observations with the circle of the Observatory of T. C. Dublin, and also the North Polar distances of the same stars from the Catalogue of 1813* reduced to 1823.†

The column of differences shows that there are none greater than what may be attributed to accidental circumstances, especially when it is considered that the Catalogue of 1813 was formed from a small number of observations of each star. The mean difference $= + 0'',2$, whereas the mean difference of Mr. POND's Catalogues $= + 1'',1$. In this then our instruments are at variance. The discordance appears much more striking if we examine the differences that exist as to certain stars. It is from these, unless I am much mistaken, I shall be enabled to show the greater exactness of the Dublin instrument. But it may be useful to add a few remarks respecting the *mean difference*, to show there are reasons for supposing a constant error, which, being allowed for, would considerably reduce the above mean difference of $1'',1$.

By Table I. it appears, the mean difference between the Dublin Catalogue of 1813, and the Greenwich Standard Catalogue of 1813 $= + 0'',47$. The mean difference between

* Trans. R. I. Academy, Vol. 12, p. 69.

† To the Catalogue which was published in the Journal of Science, October, 1822, have been since added several stars, viz. α Persei, Rigel, α Hydræ, 2 α Libræ, α Herculis, and α Pegasi. In that Catalogue, the mean difference from that of 1813 was exactly $0'',0$.

the Catalogues of 1823 = − 0″,10. Now, supposing for a moment these differences are errors belonging to the Greenwich instrument; that is, the Catalogue of 1813 is in defect = 0″,47, and the Catalogue of 1823 is 0″,10 in excess. Here then the mean southern motion would be reduced by 0″,6, and there would remain only 0″,5 to be accounted for, half of which *might* be accounted for by a circumstance to be mentioned presently.

The error I suppose in the Catalogue of 1823 is so small, that the observations by reflection cannot be adduced to controvert it; this, as I have mentioned, could not even be done had the supposed error been much greater, in consequence of the latitude having been assumed. The observations by reflection have only shown the consistency of the North Polar distances, not their absolute exactness.

The N. P. D. of the Pole Star in the Standard Catalogue of 1813

	°	′	″
	= 1	41	21,6
10 years variation = 19″,457 × 10		− 3	14,6
Predicted, 1823	1	38	7,0
Observed, 1823	1	38	7,5
			0,5 South.*

Mr. POND has not remarked this apparent southern motion of the Pole star, which is so nearly equal to the sum of the mean differences of the Greenwich and Dublin Catalogues of 1813 and 1823. It is highly probable, that this apparent southern motion of the Pole star has arisen from small errors in determining the place of the Pole star at each period.

* Excepting error, if any, from lunar nutation.

It will be remarked in the Catalogue, Table III., that the Pole star, as determined with the Dublin instrument at the two epochs, agrees exactly.

Predicted, 1823,	1° 38′ 7″,3
Observed,	1 38 7 ,3

This is a mean between Mr. Pond's observed and predicted places.

A circumstance above alluded to is of some importance. In Table IV. will be found the annual variations as found by Mr. Pond, by myself, and by Mr. Bessel. Mine are between those of the other two, but nearer to Mr. Pond's than to Mr. Bessel's. The effect of this would be, as to mine, to reduce the mean southern motion of Mr. Pond, about a quarter of a second; but if Mr. Bessel's annual variations be adopted, they would, in conjunction with the above supposition relative to the Pole star, intirely take away the mean southern motion of Mr. Pond's Catalogue.

It will be found, I conceive, difficult, in forming a Catalogue of stars by a mural circle, to avoid a small constant error, and if the Greenwich observations of the Pole star be consulted from the beginning, we shall find enough to induce us to suppose, that such errors may exist in one or both of the Greenwich Catalogues of 1813 and 1823.

In respect to the annual variations, I shall not venture to give an opinion whether Mr. Pond's or Mr. Bessel's be more exact. I shall only state that mine, which are generally between the two, were formed, as will easily be seen on examination, by a careful comparison of my Catalogue of 1823, with the Catalogue* deduced by Mr. Bessel from Dr. Bradley's observations.

* Astron. Fundament, p. 138, &c.

The above remarks, relative to the mean difference of Catalogues, have been adduced only because I hope they will be found to contain some useful illustration on this subject.

The proofs I shall now bring of the non-existence of a southern motion, are derived from comparing, in years remote from each other, the places of particular stars, supposed by Mr. POND to have a considerable southern motion, with others supposed to have none, or only a very small southern motion. Whatever doubt may arise when we reason on such small quantities as the mean difference, none can occur with respect to several particular stars that have been supposed to have a great southern motion.

The conclusion that follows is, that there is no southern motion similar to what Mr. POND has deduced. There may be certain stars of which the proper motions are not uniform. In some stars these may have a tendency to diminish, and in others to increase, but nothing of this kind is as yet certainly known. Perhaps, hereafter, it may be confirmed that the proper motion of Procyon is increasing.

(I) The stars α Cassiopeæ and γ Ursæ Majoris, are particularly considered by Mr. POND. According to him, α Cassiopeæ appears to have a considerable southern motion relatively to γ Ursæ Majoris.

It is a somewhat singular circumstance, that Dr. BRADLEY observed, with great care, at Wanstead, in 1727 and 1728, the difference of declination between these two stars. It is worth while to quote his own words.*

" But as it may be of some use to future astronomers to
" know what were the mean differences of declination, at a
" given time, between some stars that lie nearly opposite to

* Phil. Trans. Vol. 45. Old Abridg. Vol. 10, p. 51.

" one another in right ascension, and not far from either of " the colures, I shall set down the result of the comparison " of a few that differ so little in declination, that I could " determine the quantity of that difference with great cer- " tainty." He then states, that the *mean* difference of declination was 10′ 28″,1, on March 27, (old stile) 1727. This, reduced to January 1, 1727, new stile, is 10′ 38″,4.

The declinations of these stars in 1755, reduced from Dr. BRADLEY'S observations with the Greenwich quadrant, by Mr. BESSEL,* are

α Cassiopeæ	55° 11′ 23″,7
γ Ursæ Maj.	55 3 24 ,4
Difference	7 59 ,3

Dr. MASKELYNE observed these stars at Schehallien, 1774. The observations† of the zenith sector, reduced to January 1, 1774, by the usual equations, give

Z. D. α Cassiop.		Z. D. γ Ursæ Maj.	
Oct. 2	1° 22′ 45″,5	Oct. 14	1° 43′ 22″,2
3	43 ,5	15	25 ,4
5	45 ,7	18	23 ,4
24	46 ,4	22	22 ,3
Mean	1 22 45 ,3	Mean	1 43 23 ,3
			1 22 45 ,3
		Diff. decl.	20 38 ,0
		Diff. ref.	+ 0 ,4
			20 38 ,4

M. PIAZZI,‡ Palermo.
Declination, 1800.

γ Ursæ .	54° 48′ 23″,0
α Cassiop.	55 26 17 ,6
Diff.	37 54 ,6

* Astron. Fund. pp. 140, 208. † Phil. Trans. Vol. 65.

‡ M. PIAZZI's Great Catalogue, " Panormi, 1814."

Hence this Table

		Observed Difference of Declination.	Variation in 10 Years.	At	Reduced to 1780.
		′ ″	′ ″		′ ″
1727	Dr. BRADLEY, Wanstead.	+10 38,4	6 39,2	1741	6 39,0
1755	Dr. BRADLEY, Greenwich.	— 7 59,3	6 39,5	1764	6 39,4
1774	Dr. MASKELYNE, Schehallien.	—20 38,4	6 38,6	1787	6 38,6
1800	M. PIAZZI, Palermo.	—37 54,6	6 38,4	1812	6 38,5
1823	Dr. BRINKLEY, Dublin.	—53 11,0			

The last column is deduced from the fourth, by computing from* the secular variation of annual precession in diff. decl. Table III. $= + 0'',067 - 0'',029 = + 0'',038$.

The mean of the last column is $6' 38'',9$, the same as that deduced by comparing the Greenwich observations of 1755, with the Dublin of 1813.

The variations in the last column agree so nearly, that there cannot be a doubt that the apparent motions of declination of these stars have been uniform for upwards of ninety years.

(II.) The observations made in France with a sector, in 1739 and 1740,† appear to have been exact, by comparing the amplitudes of the same arc determined by different stars.

The lunar nutation was then unknown ; but if we correct the observations for this, and solar nutation, we may then deduce the differences of declination of certain stars, and compare them with later observations.

According to Mr. POND, Capella has a considerable south-

* The secular variation is here and elsewhere given retrospective.

† La Merid. Verif. p. lxxxiii., &c.

ern motion relatively to η Ursæ Majoris, viz. at the rate of 1″,9 in ten years, at 1818 greater than at 1784.

(I.) Capella and η Ursæ Majoris observed at Paris.

Z. D. Jan. 1, 1740.

Capella	3° 8′ 28″,6 S.	η Ursæ Maj.	1° 47′ 7″,7. N.
Sol. and lunar nut.	— 5 ,7		— 7 ,6
	3 8 22 ,9		1 47 0 ,1 N.
			3 8 22 ,9 S.
		Diff. decl.	4 55 23 ,0*

	Greenwich, 1755, decl.		Palermo, 1800 decl.		Dublin, 1823, N.P.D.
Capella .	45° 43′ 4″,8		45° 46′ 37″,5		44° 11′ 36″,2
η Ursæ Maj.	50 32 39 ,0		50 18 59 ,2		39 47 59 ,9
Diff.	4 49 34 ,2		4 32 21 ,7		4 23 36 ,3
Paris, 1740	4 55 23 ,0		4 49 34 ,2		4 32 21 ,7
(15 years)	5 48 ,8	(45 y.)	17 12 ,5	(23 y.)	8 45 ,4

The secular variation of annual precession in diff. of declination for these two stars is +,622 +,153 = +,675. Vide Table III.

Hence,

Rate at 1747	in ten years	3′ 52″,5	reduced to 1780	3′ 50″,3
at 1777		3 49 ,4		3 49 ,2
at 1812		3 48 ,4		3 50 ,5

* The result from the observations at Bourges is 4° 55′ 22″,8. This close agreement must be accidental. But the observations in general may be considered as exact. It is worth while mentioning here the latitude of the Royal Observatory, at Paris, as deduced by comparing the Dublin north polar distances 1823, with the zenith distances of three stars observed at Paris, 1739 and 1740,

Capella gives lat. =	48° 50′ 14″,0
η Ursæ Maj. - - - -	13 ,1
γ Draconis - - - - -	17 ,4
Mean	48 50 14 ,8

This differs so little from 48° 50′ 14″, the lat. according to the latest determination, that it shows also we can calculate the motions of these stars pretty exactly for eighty years.

This is as great a coincidence, allowing for unavoidable errors, as could be expected from the most uniform variation. The difference that exists between the 2nd and 3rd, is contrary to a southern motion

(2) γ Draconis and α Cygni,

	Dunkirk, 1740, Z. D.		Greenwich, 1755, decl.		Palermo, 1800, decl.		Dublin, 1823, N.P.D.
γ Draconis	0° 29′ 47″,0 N		51° 31′ 40″,6		51° 31′ 4″,5		38° 29′ 10″,3
α Cygni -	6 40 12 ,8 S		44 24 56 ,7		44 34 19 ,8		45 20 52 ,0
Diff.	7 9 59 ,8		7 6 43 ,9		6 56 44 ,7		6 51 41 ,7
			7 9 59 ,8		7 6 43 ,9		6 56 44 ,7
		(15 y.)	3 15 ,9	(45 y.)	9 59 ,2	(23 y.)	5 3 ,0

The secular variation of annual precession in diff. of decl. $= +,202 -,227 = -,025$.

Hence,

Rate at 1747	in ten years	2′ 10″,6	reduced to 1780	2′ 10″,7
at 1777		2 13 ,1		2 13 ,1
at 1812		2 11 ,7		2 11 ,6

The coincidence here is not so great as before, but there is nothing the least in favour of a southern motion in α Cygni.

(III.) The observations* made by the late General MUDGE, with the zenith sector, in 1802, appear to concur in evidence against the southern motion, by a comparison of the place of Capella with those of γ and η Ursæ Maj. and γ Draconis.

The instrument with which these observations were made, and the care† used in making them, entitle them to great weight.

* Philosophical Transactions, 1803.

† It is necessary to remark, that the computations, as given in the Philosophical Transactions, were not made with the same care as the observations. This explains the different results which appear here. For Capella, the lunar nutation appears to have been anplied the wrong way.

(1) Mean zenith distance, January 1, 1802.

	Dunnose.	Arbury Hill.	Greenwich.
γ Ursæ Maj.	4° 10′ 37″,8 N	2° 34′ 16″,8 N	3° 19′ 6″,0 N
Capella . .	4 50 21 ,7 S	6 26 41 ,4 S	5 41 51 ,0 S
	9 0 59 ,5	9 0 58 ,2	9 0 57 ,0
	Mean of the three	= 9 0 58 ,2	

	Greenwich, 1755, decl.	Mean from Z. Sect. 1802.	Dublin, Jan. 1, 1823.
Capella . .	45° 43′ 4″,8	Diff. 9° 0′ 58″,2	44° 11′ 36″,2
γ Ursæ Maj.	55 3 24 ,4	9 20 19 ,6	35 19 15 ,1
	9 20 19 ,6	(47 y.) 19 21 ,4	8 52 21 ,1
			9 0 58 ,2
		(21 y.)	8 37 ,1

The secular variation of annual precession = + 0″,622 — 0,029 = + ,593.

Hence,

Rate at 1778 } at 1813 } in ten years { 4′ 7″,1 } { 4 6 ,2 } reduced to 1780 { 4′ 7″,0 } { 4 8 ,1 }

This discordance, contrary to the southern motion, may be safely attributed to the errors of observation.

(2) If we compare η Ursæ Majoris and Capella,

	Dunnose.	Clifton.	Arbury Hill.	Greenwich.
η Ursæ Maj.	0° 18′ 45″,5 S	3° 9′ 9″,2 S	1° 55′ 6″,2 S	1° 10′ 17″,8 S
Capella	4 50 21 ,7 S	7 40 42 ,7 S	6 26 41 ,4 S	5 41 51 ,0 S
	4 31 36 ,2	4 31 33 ,5	4 31 35 ,2	4 31 33 ,2
The Mean is	4 31 34 ,5			

We may now refer back to (II.) (1), and instead of the Palermo diff. of declination, insert this, and we shall obtain,

Rate at 1747 for ten years, gives rate for ten years at	1780	3′ 49″,9
1778 ———————————————	1780	3 49 ,5
1813 ———————————————	1780	3 49 ,9

This, therefore, shows a uniform variation.

(3) Capella and γ Draconis.

	Dunnose.	Clifton.	Arbury Hill.	Greenwich.
γ Draconis	0° 53′ 56″,7 N	1° 56′ 26″,9 S	0° 42′ 22″,9 S	0° 2′ 24″,6 N
Capella .	4 50 21 ,7 S	7 40 42 ,7 S	6 26 41 ,4 S	5 41 51 ,0 S
	5 44 18 ,4	5 44 15 ,8	5 44 18 ,5	5 44 15 ,6
Mean difference	5 44 17 ,1			

	Greenwich, 1755, decl.		From Z. Sector. Mean diff.		Dublin. 1823, N.P.D.
Capella - -	45° 43′ 4″,8		- - - -		44° 11′ 36″,2
γ Draconis - -	51 31 40 ,6		- - - -		38 29 10 ,3
Diff.	5 48 35 ,8		5 44 17 ,1		5 42 25 ,9
			5 48 35 ,0		5 44 17 ,1
		(47 y.)	4 18 ,7	(21 y.)	1 51 ,2

The secular variation of annual precession in diff. of decl. $= +,622 + ,202 = +,824$.

Hence,

Rate at 1778 } in ten years { 55″,0 } reduced to 1780 { 54″,9
at 1813 } { 52 ,0 } { 54 ,7

a result supporting a uniform variation.

It may not be without its use in this enquiry, to show what the latitude of Greenwich comes out independently on the mural circle, viz. by reducing the zenith sector observations of 1802 to 1823 (applying an uniform variation, viz. that deduced from the variations in 1789, by allowing the changes in precession) and then computing from the north polar distances for 1823, determined by the Dublin observations.

Mean Z. D Greenwich, Jan. 1, 1802.

	γ Draconis.	γ Ursæ Maj.	η Ursæ Maj.	Capella.
	0° 2′ 24″,6 N	3° 19′ 6″,0 N	1° 10′ 17″,8 S	5° 41′ 51″,0 S
Reduction to 1823	− 14 ,7	− 7 0 ,0	+ 6 21″,8	− 1 35 ,3
	0 2 9 ,9	3 12 6 ,0	1 16 39 ,6	5 40 15 ,7
Dublin, N. P. D.	38 29 10 ,3	35 19 15 ,1	39 47 59 ,9	44 11 36 ,2
Co-lat. Greenw.	38 31 20 ,2	38 31 21 ,1	38 31 20 ,3	38 31 20 ,5

The mean of these gives the latitude of Greenwich 51° 28′ 39″,5, or one-tenth of a second less than what Mr. Bessel found from his admirable investigations on Dr. Bradley's observations. He strongly contends for the exactness of 51° 28′ 39″,6, which is 0″,6 more than that recently assumed by Mr. Pond.

(IV.) Two stars in which Mr. Pond finds a great southern motion are γ and α Pegasi.

These two stars were observed by General Lambton, at his station of Dodagoontah, in the Mysore, at the same time that α Serpentis was also observed.* For α Serpentis, Mr. Pond finds none, or a very small, southern motion.

We have hence an opportunity of comparing the relative changes of N. Polar distance of these stars and α Serpentis.

An examination of the observations in the Asiatic Transactions will show, that for stars so near the zenith, much reliance may be had on the results of the observations.†

(1) γ Pegasi and α Serpentis.

	Greenwich. 1755, decl.		Dodagoontah. 1805, Z. D.		Dublin, 1823, N.P.D.
α Serpentis	7° 12′ 48″,6		5° 56′ 59″,6 S		83° 0′ 36″,6
γ Pegasi -	13 49 14 ,1		1 6 4 ,2 N		75 48 0 ,4
Diff.	6 36 25 ,5		7 3 3 ,8		7 12 36 ,2
			6 36 25 ,5		7 3 3 ,8
		(50 y.)	26 38 ,3	(18 y.)	9 32 ,4

* Asiatic Transactions, Vol. 10. p. 359.

† It may be said, that the observations made at Dodagoontah were not exact, judging by the irregularities exhibited by the latitude found by different stars. But these were owing to the errors of the catalogue of declination which General Lambton possessed. If the zenith distances be reduced, and applied to either of the Dublin Catalogues of N. Polar Distances, the latitudes by each star will be found to agree.

Secular variation of annual precession in diff. decl. $= +,349 + ,013 = + ,362$.

Hence,

Rate at 1780 } in ten years { 5′ 19″,6 } reduced to 1780 { 5′ 19″,6
at 1814 } in ten years { 5 18 ,0 } reduced to 1780 { 5 19 ,2

Quantities so nearly equal, prove the uniform variation of the diff. of N. P. D. of these stars.

(2) α Pegasi and α Serpentis.

	Greenwich. 1755 decl.		Dodagoontah. 1805, Z. D.		Dublin. 1823, N.P.D.
α Serpentis	7° 12′ 48″,6		5° 56′ 59″,6		83° 0′ 36″,6
α Pegasi -	13 53 29 ,7		1 9 37 ,8		75 44 41 ,3
	6 40 41 ,1		7 6 37 ,4		7 15 55 ,3
			6 40 41 ,4		7 6 37 ,4
		(509)	25 56 ,3	(189)	9 17 ,9

Secular variation of annual precession in diff. decl. $= +,349 - ,116 = + ,233$.

Hence,

Rate at 1780 } in ten years { 5′ 11″,3 } reduced to 1780 { 5′ 11″,3
at 1814 } in ten years { 5 9 9 } reduced to 1780 { 5 10 ,7

From these small differences we cannot conclude a southern motion in these stars when compared with α Serpentis. Mr. POND's observations made it, in both γ and α Pegasi, upwards of 2″.

(V.) Sirius has, according to Mr. POND, a greater southern motion than any other star, amounting to 3″,4 for ten years, between 1813 and 1823, compared with its rate for ten years at 1784.

This star, in these latitudes, is far from the zenith, on which account, the result of the observations of M. PIAZZI,

at Palermo, will be of considerable authority in estimating the value of observations made at Greenwich, and in Dublin.

	N.P.D. Sirius.
The Cat. of M. Piazzi, gives, Jan. 1, 1800	106° 27′ 6″,2
Red. 13 y. (ann. var. 4″,40)	+ 57 ,2
Jan. 1, 1813	106 28 3 ,4
Red. 10 y. (ann. var. 4″,44)	44 ,4
	106 28 47 ,8

Hence,

	1813.	1823.
Computed from Palermo Cat.	106° 28′ 3″,4	106° 28′ 47″,8
Greenwich Cat.	0 ,7	48 ,7
Dublin Cat.	4 ,3	48 ,4

There can therefore be little doubt, that the apparent southern motion of this star at Greenwich, has arisen principally from an error in the result of the Greenwich observations of 1813.

(VI.) Several of the stars of M. Piazzi's Catalogue have been already referred to in this enquiry. It is right to remark, also, the general agreement of the Dublin Catalogue of 1813, and the N. P. D. distances for 1813, deduced from M. Piazzi's Catalogue, taking the annual variations, (reduced to 1806) that were obtained by a comparison of Bradley's Catalogue of 1755, by Bessel, with the Dublin Catalogue of 1823. These variations are given in Table V, column 5.

In this Table, in Column 1, will be found how much the respective stars of the Dublin Catalogue of 1813 are north or south of their places so computed (predicted) from the Palermo Catalogue.

It is evident here is no southern motion, the mean of all

the differences is $0'',1$ north, a remarkable confirmation of the exactness of the annual variations used.

Column 2, of Table V., shows how much the observed places, 1823, are north or south of their places, computed from the Catalogue of 1813. These results are mentioned before, and are only placed here to be seen at one view with the rest.

It has been supposed, that Mr. POND's Westbury observations afford a confirmation of the southern motion. Column 3, of Table V., shows how much the observed places, at Greenwich, 1813, are north or south of the places predicted from the Westbury Catalogue.

Column 4 contains Mr. POND's differences between his Catalogue, 1823, and the places predicted from his Catalogue, 1813. A comparison of Columns 3 and 4 will show, that the Westbury Catalogue is, in many instances, so irregularly at variance with the Greenwich Catalogues of 1813 and 1823, that no conclusion whatever can be deduced from it.

In the Conn. des Tems. 1809, p. 458, are given declinations of four stars observed by MECHAIN, with the repeating circle of BORDA, which, at first sight, may appear to support the southern motion.

The first of these stars is Capella, N.P.D. 1800, $44^\circ 13' 18'',0$. The zenith distance of this star, observed at Greenwich by General MUDGE with the zenith sector, and reduced to 1800, is $5^\circ\ 41'\ 51'',0 + 9',2$. Hence the co-lat. of Greenwich $= 38^\circ\ 31'\ 17'',8$. Therefore, either the zenith sector, or BORDA's circle, must have been in error; and had we not proof of the exactness of the sector, we could scarcely hesitate between the two instruments.

Two of the four stars above mentioned are β Tauri and Pollux. MECHAIN'S declination gives the predicted N. P. D. of β Tauri, conformable to Mr. POND'S southern motion, who makes it only 0″,7, a quantity evidently too small to found an argument on; besides, MECHAIN'S places of this star, deduced at Paris and Montjoy, differ by 1″,8.

Pollux also gives a southern motion, but Mr. POND, finds the southern motion of this star only 0″,2. Also MECHAIN'S results as to Pollux are very discordant.

MECHAIN'S declination of Sirius also seems to support the southern motion, but in this it is opposed by that of PIAZZI.

I shall conclude by mentioning a result recently obtained, that shows, in a remarkable manner, that the Dublin circle has been consistent with itself from the beginning, and has suffered no derangement.

From 1809 to 1823, inclusive, thirteen summer solstices have been observed with the circle, for which, observations on eighty seven days have been made. I have investigated from these, the maximum of *lunar nutation*, and found it = 9″,60, which happens to be exactly what I have hitherto used for the Sun. I am induced, however, to give more weight to my result from the stars, viz. 9″,26*. The difference is less than could have been expected from solar observations. It puts beyond all doubt the permanent state of the instrument. Had any circumstances taken place similar to those, of whatever nature they may be, by which the Greenwich instrument has shown so great a southern motion in certain stars, they must have given a very erroneous quantity of lunar nutation.

* Philosophical Transactions, 1821.

POSTSCRIPT.

Since the above was written, the kindness of a friend has communicated to me, by letter, Mr. POND's Paper, read in June last, and which has appeared in the Second Part of the Transactions recently published: the volume itself has not reached me, and therefore I have not seen the Tables. I find Mr. POND has referred to the Palermo Catalogue, as contained in the Philosophical Transactions, 1806. That Catalogue has been long rejected by the author. The improved places of the principal stars, as given in the great Catalogue, are those to which I have referred. This explanation appears necessary.

The exact Catalogue was first published, probably about 1807, as the Conn. des Tems. 1809, p. 458, which was published in 1807, contains the principal stars agreeing with the great Catalogue very nearly. The observations were therefore made prior to 1807. Indeed it is probable both Catalogues were founded on nearly the same observations. I beg leave to refer here to Mr. BESSEL's " Astron. Fundam. p. 297 and 298," for some remarks relative to the improved Catalogue of M. PIAZZI.

Mr. POND states, that unless the southern motion be admitted, the Greenwich observations of 1813 will appear very erroneous, and those of Dublin still more so. As I am unacquainted with the arguments by which he supports this opinion, I cannot reply to them. But I think quite the contrary, as far as regards my observations, will appear from the preceding pages. The southern motion will change every

thing in my results, as well as in those of other astronomers; whereas, without it, every thing is consistent; and I cannot but feel considerable satisfaction in the conviction, that, sidereal astronomy is a more certain science than it is represented to be in the last communication of Mr. POND to the Royal Society.

Observatory, Trinity College, Dublin,
Dec. 6, 1823.

TABLE I.

	Greenwich Catalogue. N. P. D. 1813.	Dublin Catalogue. N. P. D. 1813.	Diff.	Greenwich Catalogue. N. P. D. 1823.	Dublin Catalogue. N. P. D. 1823.	Diff.
	° ′ ″	° ′ ″		° ′ ″	° ′ ″	″
Polaris	1 41 21,6	1 41 21,8	+0,2	1 38 7,5	1 38 7,3	—0,2
β Ursæ Min.	15 4 49,0	15 4 49,4	+0,4	15 7 15,7	15 7 16,7	+1,0
β Cephei	20 15 30,6	20 15 31,4	+0,8	20 12 54,0	20 12 54,4	+0,4
α Ursæ Maj.	27 14 31,5	27 14 30,9	—0,6	27 17 43,7	27 17 44,0	+0,3
α Cephei	28 12 12,5	28 12 13,9	+1,4	28 9 42,8	28 9 42,7	—0,1
α Cassiopeæ	34 29 22,7	34 29 22,6	—0,1	34 26 5,7	34 26 4,1	—1,6
γ Ursæ Maj.	35 15 55,3	35 15 56,2	+0,9	35 19 14,8	35 19 15,1	+0,3
γ Draconis	38 29 3,7	38 29 3,7	0,0	38 29 10,5	38 29 10,3	—0,2
η Ursæ Maj.	39 44 57,9	39 44 58,4	+0,5	39 47 59,4	39 47 59,9	+0,5
α Persei	40 48 52,6	40 48 51,4	—1,2	40 46 39,2	40 46 37,9	—1,3
Capella	44 12 20,5	44 12 20,7	+0,2	44 11 36,8	44 11 36,2	—0,6
α Cygni	45 22 57,0	45 22 58,3	+1,3	45 20 52,4	45 20 52,0	—0,4
α Lyræ	51 23 0,5	51 23 0,8	+0,3	51 22 31,2	51 22 30,8	—0,4
Castor	57 42 46,7	57 42 47,5	+0,8	57 43 59,0	57 43 58,8	—0,2
Pollux	61 31 56,4	61 31 56,1	—0,3	61 33 17,0	61 33 17,2	+0,2
β Tauri	61 33 43,7	61 33 44,2	+0,5	61 33 6,5	61 33 6,7	+0,2
α Andromedæ	61 56 29,6	61 56 30,3	+0,7	61 53 12,5	61 53 12,0	—0,5
α Cor. Bor.	62 38 55,4	62 38 55,5	+0,1	62 41 0,6	62 41 0,3	—0,3
α Arietis	67 25 36,5	67 25 36,8	+0,3	67 22 44,4	67 22 43,7	—0,7
Arcturus	69 50 19,0	69 50 19,3	+0,3	69 53 29,2	69 53 29,6	+0,4
Aldebaran	73 52 35,4	73 52 36,0	+0,6	73 51 17,7	73 51 17,6	—0,1
β Leonis	74 22 57,3	74 22 56,4	—0,9	74 26 18,1	74 26 17,9	—0,2
α Herculis	75 23 14,0	75 23 14,6	+0,6	75 24 0,1	75 24 0,5	+0,4
α Pegasi	75 47 51,6	75 47 52,8	+1,2	75 44 41,8	75 44 41,3	—0,5
γ Pegasi	75 51 21,0	75 51 21,2	+0,2	75 48 2,4	75 48 0,4	—2,0
Regulus	77 7 22,7	77 7 23,1	+0,4	77 10 15,6	77 10 16,7	+1,1
α Ophiuchi	77 17 39,1	77 17 40,5	+1,4	77 18 10,6	77 18 10,5	—0,1
γ Aquilæ	79 50 0,6	79 50 1,3	+0,7		79 48 37,9	
α	81 36 58,8	81 36 59,8	+1,0	81 35 29,5	81 35 28,9	—0,6
α Orionis	82 38 15,7	82 38 15,9	+0,2	82 38 4,2	82 38 4,0	—0,2
α Serpentis	82 58 39,3	82 58 38,8	—0,5	83 0 36,6	83 0 36,6	0,0
β Aquilæ	84 3 4,1	84 3 5,2	+1,1		84 1 38,9	
Procyon	84 18 14,4	84 18 15,3	+0,9	84 19 43,3	84 19 43,0	—0,3
α Ceti	86 39 0,7	86 39 2,0	+1,3	86 36 36,8	86 36 36,2	—0,6
α Aquarii	91 13 21,6	91 13 21,7	+0,1	91 10 31,4	91 10 30,3	—1,1
α Hydræ	97 51 11,3	97 51 11,0	—0,3	97 53 44,5	97 53 44,2	—0,3
Rigel	98 25 33,8	98 25 34,3	+0,5	98 24 48,4	98 24 48,1	—0,3
Spica Virginis	100 10 51,3	100 10 51,3	0,0	100 14 0,7	100 14 2,0	+1,3
1 α Capricorni	103 4 35,4	103 4 36,1	+0,7	103 2 49,6	103 2 49,7	+0,1
2	103 6 52,3	103 6 52,0	—0,3	103 5 6,6	103 5 7,0	+0,4
2 α Libræ	105 15 22,7	105 15 22,6	—0,1	105 17 56,3	105 17 58,3	+2,0
Sirius	106 28 0,7	106 28 4,3	+3,6	106 28 48,7	106 28 48,4	—0,3
Antares	116 0 16,6	116 0 16,8	+0,2	116 1 44,1	116 1 44,1	0,0

TABLE II.

	N. P. D. Dublin. Jan. 1, 1822.	Zenith Distance. Greenwich. Jan. 1, 1822.	Co-Latitude of Greenwich.
	° ′ ″	° ′ ″	° ′ ″
β Ursæ Min.	15 7 1,9	23 24 20,0	38 31 21,9
β Cephei	20 13 9,9	18 18 11,3	21,2
α Ursæ Maj.	27 17 24,7	11 13 56,6	21,3
α Cephei	28 9 57,7	9 21 23,1	20,8
α Cassiopeæ	34 26 24,0	4 4 55,0	19,0
Capella	44 11 40,5	5 40 20,4	20,1
α Cygni	45 21 4,4	6 49 44,1	20,3
α Lyræ	51 21 33,8	12 50 13,0	20,8
Castor	57 43 51,5	19 12 31,0	20,5
Pollux	61 33 9,0	23 1 47,8	21,2
β Tauri	61 33 10,3	23 1 49,3	21,0
α Andromedæ	61 53 31,9	23 22 11,6	20,3
α Cor. Bor.	62 39 48,1	24 8 27,1	21,0
α Arietis	67 23 1,1	28 51 40,8	20,3
Arcturus	67 53 10,5	31 21 49,2	21,3
Aldebaran	73 51 25,5	35 20 4,5	21,0
β Leonis	74 25 57,9	42 54 37,1	20,8
α Herculis	75 23 55,9	36 52 34,6	21,3
α Pegasi	75 45 0,5	37 13 40,1	20,4
Regulus	77 9 59,3	38 38 37,5	21,8
α Ophiuchi	77 18 7,5	38 46 46,8	20,7
α Aquilæ	81 35 38,0	43 4 17,6	20,4
α Orionis	82 38 5,2	44 6 44,6	20,6
α Serpentis	83 0 24,9	44 29 3,7	21,2
Procyon	84 19 17,0	45 48 13,6	20,7
α Aquarii	91 11 22,0	52 39 27,7	19,8
α Hydræ	97 52 58,5	59 22 8,4	20,5
Spica Virg.	100 3 43,0	61 32 20,8	22,2
Sirius	106 28 43,9	67 57 23,3	20,6
Antares	116 1 35,6	77 30 14,4	21,2

TABLE III.

Annual Variation. 1818.	Secular Variation. 1718. = 1818.		From recent Observations, Dublin Cat. for 1823.	Computed from Cat. 1813.	Diff.
″	″		° ′ ″	″	″
−20,077	−0,013	γ Pegasi	75 48 0,4	0,4	0,0
19,866	−0,067	α Cassiop.	34 26 4,1	3,9	+0,2
19,452	– –	Polaris	1 38 7,3	7,3	0,0
17,382	−0,240	α Arietis	67 22 43,7	42,9	+0,8
14,536	−0,316	α Ceti	86 36 36,2	36,7	−0,5
13,430	−0,456	α Persei	40 46 37,9	37,1	+0,8
7,889	−0,458	Aldebaran	73 51 17,6	17,1	+0,5
4,507	−0,622	Capella	44 11 36,2	35,6	+0,5
4,690	−0,411	Rigel	98 24 48,1	47,4	+0,7
3,749	−0,540	β Tauri	61 33 6,7	6,7	0,0
−1,299	−0,473	α Orionis	82 38 4,0	3,0	+1,0
+4,444	−0,380	Sirius	106 28 48,4	48,7	−0,3
7,157	−0,527	Castor	57 43 58,8	59,1	−0,3
8,687	−0,422	Procyon	84 19 43,1	42,2	+0,9
8,054	−0,491	Pollux	61 33 17,2	16,6	+0,6
15,230	−0,273	α Hydræ	97 53 44,2	43,3	+0,9
17,281	−0,233	Regulus	77 10 16,7	15,9	+0,8
19,122	−0,160	β Urs. Maj.	32 40 16,1	15,9	+0,2
19,272	−0,160	α	27 17 44,0	43,6	+0,4
20,049	−0,036	β Leonis	74 26 17,9	16,9	+1,0
20,001	−0,029	γ Urs. Maj.	35 19 15,2	16,2	−1,0
19,700	+0,084	ε	33 4 38,2	39,1	−0,9
18,989	+0,153	Spica Virg.	100 14 2,0	1,2	+0,8
18,960	+0,122	ζ Ursæ Maj.	34 8 50,4	52,3	−1,9
18,173	+0,153	η	39 47 59,9	0,1	−0,2
18,984	+0,216	Arcturus	69 53 29,6	29,2	+0,4
15,335	+0,313	2 α Libræ	105 17 58,3	55,9	+2,4
14,765	−0,029	β Ursæ Min.	15 7 16,7	17,1	−0,4
12,449	+0,295	α Cor. Bor.	62 41 0,3	0,0	+0,3
11,740	+0,349	α Serpentis	83 0 36,6	36,2	+0,4
8,580	+0,484	Antares	116 1 44,1	42,6	+1,5
4,577	+0,387	α Herculis	75 24 0,5	0,4	+0,1
3,086	+0,400	α Ophiuchi	77 18 10,6	11,4	−0,8
+0,689	+0,202	γ Draconis	38 29 10,3	10,6	−0,3
−2,993	+0,291	α Lyræ	51 22 30,8	30,8	−0,0
8,326	+0,376	γ Aquilæ	79 48 37,9	38,1	−0,2
9,044	+0,384	α	81 35 28,9	29,4	−0,5
8,555	+0,369	β	84 1 38,9	39,7	−0,8
10,634	+0,411	1 } α Capric.	103 2 49,7	49,7	0,0
10,669	+0,411	2	103 5 7,0	5,3	+1,7
12,585	+0,227	α Cygni	45 20 52,0	52,5	−0,5
15,037	+0,131	α Cephei	28 9 42,7	43,5	−0,8
15,656	+0,064	β Cephei	20 12 54,4	54,8	−0,4
17,244	+0,227	α Aquarii	91 10 30,3	29,3	+1,0
19,285	+0,116	α Pegasi	75 44 41,3	40,0	+1,3
19,932	−0,004	α Andromedæ	61 53 12,0	11,0	+1,0

TABLE IV.

	Ann. Var. 1820. Mr. Pond.	Ann. Var. 1820. Dr. Brinkley.	Ann. Var. 1820. Mr. Bessel.
	″	″	″
γ Pegasi	— 20,09	— 20,08	— 20,03
α Cassiopeæ	19,85	19,87	—
α Arietis	17,40	17,38	17,35
α Ceti	14,59	14,53	14,49
α Persei	13,41	13,43	—
Aldebaran	7,92	7,88	7,86
Capella	4,54	4,50	4,48
Rigel	4,74	4,69	4,66
β Tauri	3,80	3,74	3,71
α Orionis	— 1,36	— 1,29	— 1,27
Sirius.	+ 4,41	+ 4,45	+ 4,48
Castor	7,12	7,16	7,19
Procyon	8,63	8,69	8,74
Pollux	8,02	8,06	8,09
α Hydræ	15,19	15,23	15,27
Regulus	17,23	17,29	17,31
α Ursæ Maj.	19,26	19,27	—
β Leonis	20,04	20,05	20,08
γ Ursæ Maj.	19,98	20,00	—
Spica Virg.	18,94	18,99	19,03
η Ursæ Maj.	18,15	18,17	—
Arcturus	18,97	18,98	19,01
1 α Libræ	15,30	—	15,40
2 α Libræ	15,32	15,33	15,37
β Ursæ Min.	14,74	14,76	—
α Cor. Bor.	12,45	12,44	12,48
α Serpentis	11,72	11,73	11,79
Antares	8,59	8,58	8,65
α Herculis	4,57	4,57	4,61
α Ophiuchi	3,08	3 08	3,12
γ Draconis	+ 0,67	+ 0,68	—
α Lyræ	— 3,02	— 3,00	— 2,96
γ Aquilæ	8,34	8,33	8,29
α Aquilæ	9,06	9,05	9,00
β Aquilæ	8,56	8,56	8,49
1 Capricorni	10,66	10,64	10,58
2 Capricorni	10,68	10,68	10,61
α Cygni	12,63	12,59	12,56
α Cephei	15,07	15,04	—
β Cephei	15,68	15,66	—
α Aquarii	17,27	17,25	17,20
α Pegasi	19,32	19,28	19,26
α Andromedæ	— 19,95	— 19,93	19,91

TABLE V.

	Diff. of Palermo Cat. 1800, and Dublin, 1813.	Diff. of Dublin Cat. 1813, and Dublin, 1823.	Diff. of Westbury Cat. 1800, and Greenwich, 1813.	Diff. of Greenwich Cat. 1813, and Greenwich, 1823.	Annual Variations, 1806.
	″	″	″	″	″
γ Pegasi	1,2 N	0,1 N	5,2 S	2,3 S	— 20,080
α Cassiopeæ	1,4 N	0,1 S		1,5 S	19,875
α Arietis	0,3 N	0,8 S	2,4 S	1,8 S	17,412
α Ceti	0,3 N	0,5 N	0,0	2,0 S	14,579
α Persei	0,2 N	0,8 S		0,9 S	13,494
Aldebaran	1,3 S	0,5 S	3,4 S	1,5 S	7,944
Capella	2,6 N	0,5 S	1,4 S	1,7 S	4,582
Rigel	0,4 N	0,7 S	0,8 N	2,0 S	4,739
β Tauri	0,7 N	0,0	0,2 N	0,8 S	3,814
α Orionis	1,5 N	1,0 S	2,0 S	2,1 S	— 1,356
Sirius	0,9 S	0,3 N	1,7 S	3,4 S	+ 4,399
Castor	0,0	0,3 N	0,4 S	0,9 S	7,114
Procyon	1,5 S	0,8 S	0,8 S	2,9 S	8,636
Pollux	0,5 N	0,6 S	0,5 N	0,2 S	7,996
α Hydræ	1,0 N	0,9 S	0,8 S	1,3 S	15,191
Regulus	0,8 S	0,8 S	4,6 S	0,6 S	17,254
β Ursæ Maj.	0,9 S	0,1 S			19,104
α	1,0 N	0,4 S		0,5 N	19,254
β Leonis	0,5 S	1,0 S	4,4 S	0,4 S	20,046
γ Ursæ Maj.	0,8 N	1,1 N		0,4 N	19,998
ε	1,7 N	0,8 N			19,710
Spica Virginis	0,2 S	0,8 S	1,4 S	0,0	19,008
ζ Ursæ Maj.	1,8 S	1,9 N			18,974
η	1,1 S	0,2 N		0,2 N	18,192
Arcturus	0,5 S	0,4 S	4,6 S	0,4 S	19,010
2 α Libræ	1,3 N	2,4 S		0,6 S	15,376
β Ursæ Min.	2,1 N	0,4 N		0,7 N	14,762
α Cor. Bor.	1,2 S	0,3 S	0,3 S	0,5 S	12,485
α Serpentis	0,7 N	0,4 S	4,1 S	0,1 S	11,782
Antares	1,6 N	1,5 S		1,6 S	8,645
α Herculis	2,2 S	0,1 S		0,4 S	4,627
α Ophiuchi	2,3 S	0,8 N	4,6 S	0,9 S	3,134
γ Draconis	1,1 N	0,3 N	0,8 S	0,2 S	+ 0,713
α Lyræ	0,1 S	0,0	3,2 S	0,8 S	— 2,959
γ Aquilæ	0,3 S	0,2 N			8,281
α	2,0 S	0,5 N	4,5 S	1,2 S	8,999
β	1,0 S	0,8 N			8,510
1 α Capricorni	2,2 S	0,1 N		1,0 S	10,586
2	0,1 N	1,7 S	2,6 S	1,0 S	10,620
α Cygni	1,3 S	0,5 N	3,4 S	1,6 S	12,558
α Cephei	2,0 N	0,8 N		0,6 S	15,022
β	2,4 N	0,5 N		0,2 S	15,647
α Aquarii	0,6 N	1,0 S	0,8 S	2,5 S	17,219
α Pegasi	0,4 S	1,4 S	4,3 S	3,3 S	19,268
α Andromedæ	1,6 N	1,0 S	1,1 N	1,8 S	19,933